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Effect of Myopic Anisometropia On Contrast Sensitivity

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Abstract:

Objective: The objective of this study is to evaluate the "Effect of Myopic Anisometropia on Contrast Sensitivity."

Methods: The duration of this Cross-sectional investigation was four months. Data was collected from Al-Mustafa Mozang Eye Hospital, the University of Lahore Teaching Hospital, and LRBT Hospital Lahore between November 2024 and January 2025. Sixty (n=60) myopic anisometropic patients ranging in age from 10 to 35, were involved in this study. Objective refraction was accomplished with Auto Refractometer (Axis tsrk 1000P), and vision was examined with Snellen LED Visual Acuity Chart (model 18.5). Measured contrast Sensitivity by the Pelli-Robson Chart using Smart Optometry app. SPSS version 27.0 was used to analyze the results.

Results: The study included 60 participants, comprising 29 males (48.3%) and 31 females (51.7%), aged between 10 and 35 years. Participants were evenly categorized into mild, moderate, and high myopic anisometropia groups, each consisting of 20 individuals (33.3%). The Kruskal-Wallis test for OD revealed a statistically significant difference ($p=0.004$), with the mild group having the highest mean rank (37.50) and contrast sensitivity (2.0425, SD= ±0.12067). For OS, a significant difference was also found ($p<0.001$), where moderate anisometropia had the highest mean rank (34.70) and high anisometropia the lowest (20.80). However, for OU no statistically significant difference was observed when all groups had equal mean ranks (30.50) and contrast sensitivity values (2.10, SD=±0.00, $p=1.00$).

Conclusion: Contrast sensitivity is affected in cases of high-degree and moderate degree myopic anisometropia when measured uniocular. However, when assessed binocularly, myopic anisometropia has no significant effect on contrast sensitivity.

Keywords: Myopia, Myopic an isometropia, Contrast Sensitivity, Smart Optometry App.

Introduction

According to the WHO, "One of the most prevalent eye conditions is a refractive error. Blurred vision is caused by light not focusing on the retina because of irregular eye shape or length". (1)

The kinds of refractive errors are near-sightedness (myopia), farsightedness (hyperopia) and astigmatism. (2) The etiology results in response to environmental influence as well as the predisposition of genetics. Genes are also responsible for determining the refractive status as they influence eye growth. (3) It has been reported to affect 70 to 90 % of the population in Asian countries, 30-40% in Europe and United States, and 10-20% in Africa. In Pakistan, a national survey found the crude prevalence of myopia to be 36.5%. (4)

Myopia can also be caused by a pathophysiological condition in which the cornea, the transparent front covering of the eye, is abnormally curved or the eyeball is too long. (5) Factors influencing the incidence of myopia include age, sex, race, ethnicity, occupation and environmental factors such as increased near work and reduced time spent outdoors. (6) Poor depth perception, headache, eye strain and blurred or double vision are among symptoms of myopic anisometropia. (7)

Anisometropia is a condition characterized by a significant difference in the refractive power between the two eyes, typically defined as a disparity of two dioptres or more. (8) Hyperopic anisometropia causes eye strain, headaches, and fatigue, especially during near tasks due to the effort to maintain clear vision. (9) Myopic anisometropia combines the both myopia and anisometropia, where one eye is more near-sighted than the other. (10) 20 to 30% of the urban people with modern lifestyles face this condition and contribute towards its increasing prevalence. This prevalence is higher in people with more exposure to screens and outdoor activities. (11) It is a prevalent condition that is found in around 9.4% of adolescents and around 2.9% to 9.4% of school-going children. The. pathophysiology of myopic anisometropia often revolves around the differential growth of the eyeballs. (12) Furthermore, lens curvature as well as cornea shape also contributes to this condition. (13)

The main impact of myopic anisometropia is visual discomfort including blurred vision and an increased risk of amblyopia or strabismus if left uncorrected. (14) Myopic anisometropias primary risk factor is its correlation with increased eye growth between the ages of 5 and 15, which raises the condition's frequency and severity. (15). There are multifaceted risk factors that are responsible for causing myopic anisometropia like family history. One or both parents having myopia are more likely to depict similar refractive errors. (16) This disorder develops as a result of environmental parameters and persistent near work. (17) Some ethnic groups have a higher prevalence of myopic anisometropia due to combination of genetic and cultural factors. Additionally, disease like diabetes and keratoconus can alter the refractive angle, resulting in anisometropia. (18)

"The capacity to see distinct sharp outlines of extremely small objects is known as contrast sensitivity". (19) It becomes more difficult to detect objects in low light or low contrast situations when myopia especially at higher degrees diminishes contrast sensitivity. (20) Decreased contrast sensitivity can have a major effect on day-to-day activities, making it harder to read, drive and recognize faces which can lower one's quality of life in general. (21) A Pelli Robson score of 2.0 has been found to represent normal contrast sensitivity. (22) The lowest contrast level a patient can identify using a letter chart is measured by the pelli-Robson contrast sensitivity test. The contrast threshold is decreased by 0.05 log Units for every correct letter when performed at 33cm using the smart optometry app. (23) Myopic Anisometropia leads to unequal image clarity and size on the retina. This makes it difficult for the brain to merge images, reducing contrast sensitivity, especially in low-light conditions. (24) As anisometropia increases, visual acuity declines significantly, while contrast sensitivity is affected to a lesser extent. (25)

Myopic anisometropia, characterized by unequal refractive errors between the eyes, disrupts binocular vision and may impact contrast sensitivity. While visual acuity impairment in

anisometropia is well-documented, the specific effects on contrast sensitivity remain less explored. Reduced contrast sensitivity can affect daily activities like night driving, reading, and object recognition in low-light conditions. Understanding how myopic anisometropia alters contrast perception is crucial for improving diagnosis, treatment, and visual rehabilitation strategies. This study aims to assess the extent of contrast sensitivity loss in myopic anisometropic patients and explore potential corrective measures to enhance visual function.

Material/Subjects/Patients and methods

A descriptive cross-sectional design was implemented in this empirical study and was carried out AL-Mustafa Mozang eye hospital, The University of Lahore Teaching Hospital and LRBT Hospital Multan Road. The research comprises from October 2024 to January 2025. A sample size of 60 participants was determined using the open epi tool formula: n= [DEFF*Np(1−p)]/ [(d2/Z21-α/2*(N−1) +p*(1−p)]. The participants were selected using a non-probability convenient sampling technique.

To be eligible for inclusion, indiviuals had to be diagnosed with myopic anisometropia and be between the ages of 10 to 35 years. Additional inclusion criteria required participants to have a minimum of 6/9 in best-corrected perception VA, with no history of amblyopia treatment, ocular pathology or previous ocular surgery. Exclusion criteria included indiviuals with ocular pathology, media opacity, trauma, uncorrected refractive error, nystagmus, strabismus or any history of ocular surgery. Mentally retarded patients were also excluded from the study to ensure reliable data collection.

The study began by inviting eligible participants, ensuring that they met the inclusion criteria. Objective refraction was performed using an Auto Refractometer (Axis tsrk1000P). patients were seated and instructed to focus on the device, and readings were recorded for both eyes. Following this, visual acuity was assessed using a Snellen LED Visual Acuity Chart (model 18.5) at a 6-meter distance. With each eye tested separately, and the smallest readable line noted. Contrast sensitivity was then evaluated using the pelli-Robson chart via the Smart Optometry app. Patients were instructed to read letters aloud, identifying the most minimal contrast level at which a pair of letters may be accurately identified by at least two of the three.

Results were documented meticulously, ensuring completeness and confidentiality. The analysis principal goal was to determine the effects of myopic anisometropia on contrast sensitivity and whether the condition had a significant under uniocular and binocular conditions. This study contributes to understanding the visual performance of anisometropic indiviuals and provides insights for future research and clinical applications.

Results:

This research investigation included 60 participants, consisting 29 men (48.3%) and 31 women (51.7%), aged between 10 and 35 years. Participants were evenly categorized into mild, moderate, and high myopic anisometropia groups, each consisting of 20 individuals (33.3%). The Kruskal-Wallis test for OD revealed a statistically significant difference (p=0.004), For OD, the mild group had the highest mean rank (37.50), followed by moderate (30.23) and high (23.78) with mean and SD deviation (2.0425 ± 0.12067). For OS, the mild group had the highest mean rank (36.00), followed by moderate (34.70) and high (20.80) with mean and SD deviation (2.0225 ± 0.19624). For OU, the mild group had the highest mean rank (36.00) compared to moderate and high groups with mean and SD deviation (2.10 ± 0.00).

Table no.1 depicts the gender distribution of the study participants. Out of the 60 participants, 29 (48.3%) were male and 31 (51.7%) were female, indicating a nearly equal distribution between genders.

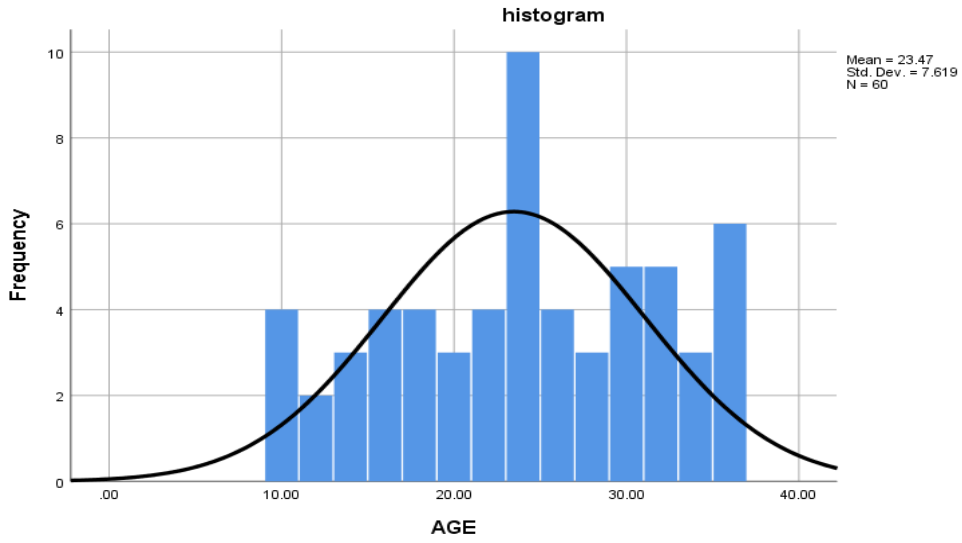
However, table no. 2 summarizes the distribution of participants according to the severity of

myopic anisometropia. Participants were categorized into mild (n=20, 33.3%), moderate (n=20, 33.3%) and high (n=20, 33.3%) severity groups.

Table no. 3 represents the mean rank values from the Kruskal-Wallis test for OD, and OS across different levels of myopic anisometropia. For OD the mild group had the highest mean rank (37.50) and mean contrast sensitivity of 2.0425 (SD=0.12067) followed by moderate (30.23) and high anisometropia had the lowest mean rank (23.78). Mild anisometropia had a mean rank of 36.00, with a mean contrast sensitivity of 2.0225 (SD = 0.1962), p=0.004. For OS, Moderate anisometropia had a mean rank of 34.70. High anisometropia had the lowest mean rank (20.80). A statistically major variation was found between the groups, $p < 0.001$.

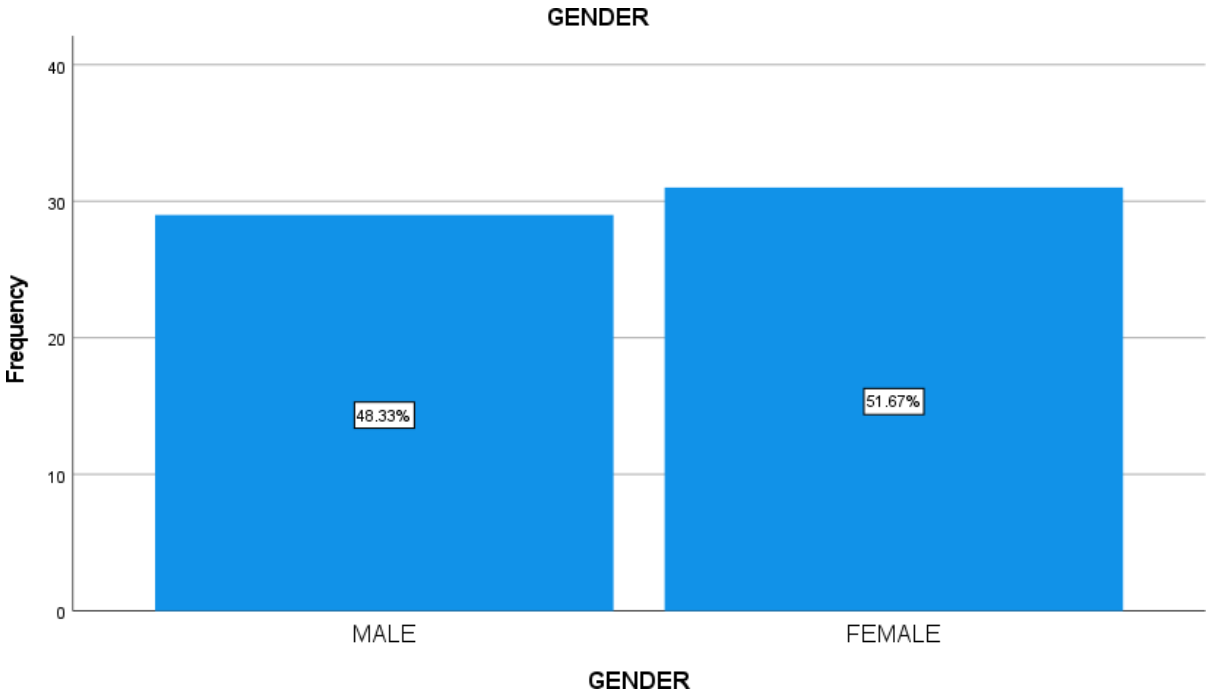
Table no. 4 shows that the Mild, moderate, and high anisometropia all had equal mean ranks (30.50) and identical mean contrast sensitivity values of 2.10 (SD = 0.00). The test result showed no statistically significant difference, p = 1.00.

Figure-1:



This figure shows the frequency of participants from each group, the maximum age was 35 years and the minimum age was 10 years among the participants.

Figure-2:



This graph shows the total patients which were 60 male and female, out of which males were 29 and females were 31 with percentages of 48.33% and 51.67% respectively.

Discussion:

In a previous similar study Abdullah Bilal et al in 2020 evaluated contrast sensitivity in myopic anisometropia. To evaluate the impact on Contrast Sensitivity, 31 indiviuals in total had varying degrees of myopic anisometropia. Compared to monocular contrast sensitivity, binocular contrast sensitivity was superior. Better contrast sensitivity was demonstrated by mild to moderate myopes, while lower contrast sensitivity was demonstrated by severe refractive errors. (26) in the same way in this research most of the mild myopic anisometropic patients likely maintain higher level of contrast sensitivity compared to those with moderate or high anisometropia. Higher degrees of anisometropia may impair contrast sensitivity due to increased refractive disparity between the eyes, which disrupt binocular vision.

Another study was carried Farah Naheed et al in 2024 did a study to determine the contrast sensitivity and its comparison among anisometropia and strabismic patients. The study was done to determine the assessment of contrast sensitivity and its comparison concerning anisometropia and strabismic amblyope. Forty- five people were included in this study. Patient history along with ocular history were also assessed. For data collection, the Pelli Robson chart was used to assess contrast sensitivity. The evaluations outcomes demonstrated that out of the sample, twenty-one were anisometropia amblyopes and twenty-four were strabismic amblyopes. Furthermore, it was seen that visual acuity and contrast sensitivity seemed to be associated with one another ($p<0.05$). Additionally, anisometropia and contrast sensitivity had a negative correlation with one another ($p<0.05$). On the contrary, no association was seen between the magnitude of strabismus with contrast sensitivity ($p<0.05$). based on these findings the contrast sensitivity seemed to decrease in both groups and it also showed an association with visual acuity and anisometropia. No relationship between contrast sensitivity and magnitude of strabismus was

seen. (27) but in current research the presence of anisometropia can differentially affect monocular and binocular contrast sensitivity. These findings suggest that the severity of anisometropia influences refractive error patterns with milder anisometropia.

Conclusion:

Descriptive statistics result conclude that contrast sensitivity is affected in cases of high-degree and moderate-degree myopic anisometropia when measured uniocular. However, when assessed binocularly, myopic anisometropia has no significant effect on contrast sensitivity. The study had several limitations that should be considered. Firstly, the sample size was relatively small, which may affect the generalizability of the findings. Additionally, variations in testing methods could have influence the accuracy of the results. The study did not assess the long term effects of myopic anisometropia, as data were collected during a single visit only. Based on the findings of the study, the following recommendations can be made: Conduct larger studies with different populations. Study long-term effects on contrast sensitivity. Check how glasses, lenses, and surgery help. See how vision loss affects daily life.

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Table-1: Frequency Distribution of Gender

Gender Distribution	**Frequency (n)**	**Percentage %**
Male	29	48.3 %
Female	31	51.7 %
Total	**60**	**100.0%**

Table-2: Frequency Distribution of Degree of Myopic Anisometropia

Degree of myopic anisometropia	**Frequency (n)**	**Percentage %**
Mild	20	33.3%
Moderate	20	33.3%

High	20	33.3%
Total	**60**	**100.0**

Table-3: Kruskal-Wallis test Ranks for Degree of Myopic Anisometropia

Degree of Myopic Anisometropia		**N**	**Mean Rank**	**Mean ± Std. Deviation**	**P-value**
OD	Mild	20	37.50	2.0425 ± 0.12067	0.004
	Moderate	20	30.23		
	High	20	23.78		
	Total	60			
OS	Mild	20	36.00	2.0225 ± 0.1962	<.001
	Moderate	20	34.70		
	High	20	20.80		
	Total	60			

Table-4: Kruskal-Wallis test Ranks for Degree of Myopic Anisometropia

Degree of Myopic Anisometropia		**N**	**Mean Rank**	**Mean ± Std. Deviation**	**P-value**
OU	Mild	20	30.50	2.10 ± 0.00	1.00
	Moderate	20	30.50		
	High	20	30.50		
	Total	60			